

# Periodic Trends

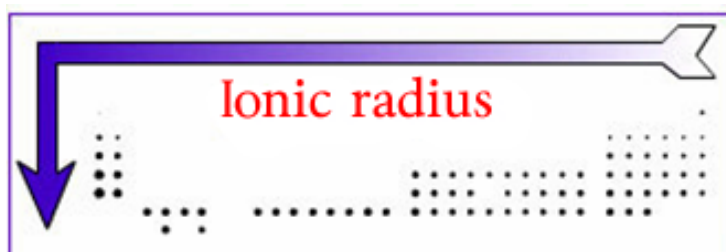
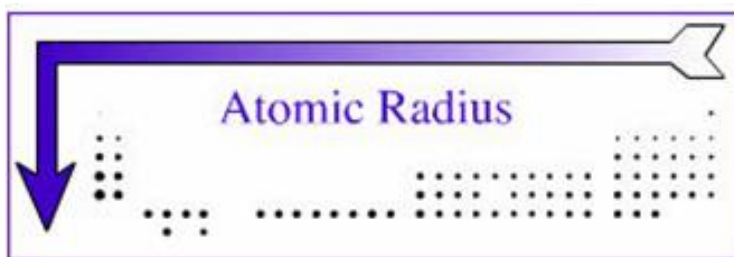
## Brief description

The Periodic table is a list of the chemical elements arranged into **Groups** (the columns going down) and **Periods** (the rows going across). The group number can be used to identify the number of valence (outer shell) electrons around the atom. The period number is the same as that of the outer energy shell. Each successive element in a period of the table increases by one in atomic number

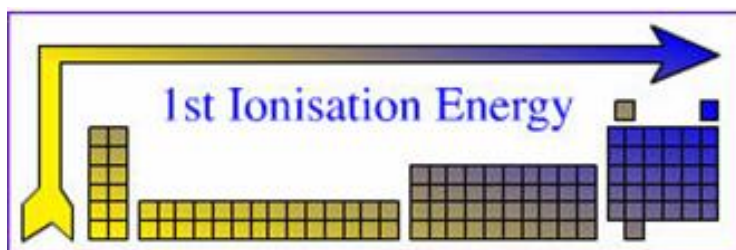
## Trends in Physical properties

### Part 1: Definitions

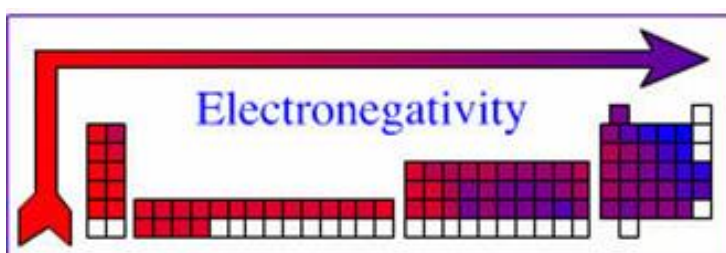
**Atomic radius** is the half the distance between the nuclei of two of the same atoms which are side by side



**First ionization energy** is the energy required to remove one mole of electrons from one mole of atoms in the gaseous state.



**Electronegativity** is a measure of the attraction an atom has for a shared pair of electrons when it is covalently bonded to another atom.



## Part 2: Physical properties down a group

Going down a group, the atomic radius and ionic radius increase due to an increase in the number of electron shells surrounding the nucleus.

The ionisation energy and electronegativity decrease because

- i) **there is a decrease in** the electrostatic attraction between the positive protons in the nucleus and the negative electrons in the electron shells orbiting the nucleus and
- ii) the valence electrons are shielded by the inner electron shells

←  
{ Shielding means that there is an increase in electron-electron repulsion due to the increase in the number of electron shells }

The greater the distance between the valence shell and the nucleus, means a decreased electrostatic attraction between nucleus and electrons in the outer shell so therefore less energy is required to remove an electron from the outer shell (ionization energy).

The melting points (of metals) decrease because the increase in radius of the positive metallic ion results in a weaker attraction between the positive ion and the shared electrons, therefore a weaker metallic bond. The melting point increases down group 7 because the elements are diatomic, non-polar molecules with weak intermolecular (van der Waals) forces between molecules. Down a group there is an increase in the number of electrons so an increase in the strength of weak intermolecular forces between molecules which results in a higher melting point.

## Part 3: Physical properties across Period 3

The atomic radius decreases going across a period because, although the number of protons increases, the electrons are being added to the same energy shell. This means the electrostatic attraction between nucleus and valence electrons increases and the radius decreases.

The ionic radius generally decreases going across a Period because the number of protons (or nuclear charge) of each ion increases across the Period, thus pulling the outer electrons closer to the nucleus. For the metals in Period 3, the ionic radii decreases, a positive ion has a smaller radius than the original atom, this is because the metals have lost 1 or more electrons.

Silicon can be represented as a positive ( $\text{Si}^{4+}$ ) or negative ( $\text{Si}^{4-}$ ) ion.

For the non-metals in Period 3, the ionic radii decreases.

Negative ions have a larger ionic radii than the original atom as negative ions have extra negative charges which introduce more electron-electron repulsion.

Negative ions have a larger ionic radii than positive ions, as negative ions have 1 more shell of electrons than the positive ions.

The electronegativity and ionisation energy increase across a period because of the increased attraction of the positive protons in the nucleus for the valence electrons which are in the same shell.

Silicon can be represented as a positive ( $\text{Si}^{4+}$ ) or negative ( $\text{Si}^{4-}$ ) ion because the formation of negative ions results in increased electron-electron repulsions that leads to an increase in radius.

For non-metals in Period 3, the ionic radii decreases. Negative ions have a larger ionic radii than the original atom as negative ions have extra negative charges which introduce more electron-electron repulsion. Negative ions have a larger ionic radii than positive ions, as negative ions have 1 more shell of electrons than positive ions.